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TABLES

FOR

QUALITATIVE ANALYSIS.

TO ACCOMPANY

CONINGTON'S HANDBOOK OF ANALYSIS.

TABLES

FOR

QUALITATIVE ANALYSIS.

TO ACCOMPANY

CONINGTON'S HANDBOOK OF ANALYSIS.

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TABLES FOR QUALITATIVE ANALYSIS.

Table I. *Preliminary Examination.* — Behaviour of inorganic bodies at a high temperature, either alone, or in presence of reducing agents.

Table II. *Preliminary Examination.* — Behaviour of metallic oxides before the blowpipe with microcosmic salt and borax.

Table III. *Treatment of Insoluble Substances.* — Conversion of insoluble substances into soluble compounds.

Table IV. *Examination for Metals.* — Behaviour of metallic solutions with hydrochloric acid, hydrosulphuric acid, sulphide of ammonium, and carbonate of ammonium, successively applied.

Table V. *Examination for Metals.* — Precipitate produced by hydrosulphuric acid in a warm acid solution.

Table VI. *Examination for Metals.* — Precipitate produced by sulphide of ammonium in presence of chloride of ammonium.

Table VII. *Examination for Metals.* — Precipitate produced by carbonate of ammonium, in presence of chloride of ammonium and free ammonia.

Table VIII. *Examination for Metals.* — Metals which are not precipitated either by hydrosulphuric acid, sulphide of ammonium, or carbonate of ammonium.

Table IX. *Preliminary Examination for Acids.* — Behaviour of the most important acids on heating their salts with concentrated sulphuric acid.

Tables X. and **XI.** *Examination for Acids.* — Behaviour of the most important acids with reagents in the wet way.

Table XII. *Silicate Analyses.* — Behaviour of natural silicates to acids.

Table I.

I. Behaviour of Inorganic Bodies at a high tempera

1. *Are readily volatile when heated on charcoal or platinum-foil, or in a dry test-tube:*	**Ammonium-**, **Mercury-**, and some **Arsenic-** compounds compounds are decomposed by heat, and are generally blacke
2. *Melt, without volatilising or changing colour:*	Most **Alkaline**, and some **Alkaline-earthy, salts.** The Zeolites). **Borates** and **Alum** swell up: **Chloride of muth, Zinc, Tin,** are easily fusible before the blowpipe:
3. *Detonate when heated on charcoal:*	**Nitrates, Chlorates, Perchlorates, Bromates, Iods**
4. *Are infusible or difficultly fusible, and do not change colour:*	The oxides and salts of the **Earthy** and **Alkaline-earth** the earths have no alkaline reaction. **Silica** and many **Sil Iridium, Palladium, Rhodium,** are infusible before t
5. *Become of a darker colour on heating:*	**Oxides and Salts of Zinc** (with greenish-yellow incandesce **Mercury** (and **Chromates**), become brown.
6. *Colour the outer blowpipe flame when heated on platinum-wire (if in the form of metallic salts, on charcoal):*	Yellow. **Sodium.** Violet. **Potassium** (except the borate and phosphate). Crimson. **Lithium, Strontium.*** * Especially after moistening with hydrochloric acid or additio † Especially on addition of chloride of silver. ‡ Metallic phosphates and borates, after moistening with sulph
7. *Moistened with cobalt-solution, and strongly heated on charcoal, give:*	Blue glass. Alkaline **Phosphates.** **Borates.** **Silicates.** Blue infusible mass. **Aluminium**, and many of its compounds. **Earthy Phosphates.** **Silica**, and many **Silicates.** **Earths.** **Zinc-ox Titanic Binoxid Antimo Niobic**
8. *Heated on charcoal with carbonate of sodium (or carbonate of sodium and cyanide of potassium) in the inner flame, give:*	Garlic smell. Most **Arsenic** compounds. Alkaline Sulphide* (Selenide or Telluride.) All compounds containing **Sulphur** (Selenium or Tellurium). Met Malleable shin **Tin, Silver, Copper,** re **Gold,** yello * The mass, when moistened, stains metallic silver black, and when heated with acids evolves hydrosulphuric (hydroselenic or hydrotelluric) acid.
9. *Heated in a glass tube open at both ends, held obliquely, give:*	Gases having a peculiar smell. **Sulphides** (of burning sulphur). **Selenides** (of horse-radish). **Arsenides** (of garlic). Many **Ammoniacal** compounds (of ammonia). **Fluorides** (on addition of microcosmic salt). Metallic s Many **Arsenic** compounds addition of sodium).
10. *In contact with zinc and hydrochloric (or sulphuric) acid, colour the solution:*	Violet or blue. **Titanic acid.** Blue. **Tungstic acid** (chlorides of Tantalum and Niobium). Blue, cha

ure, either alone, or in presence of reducing agents.

Sulphur and its acids: **Water**, &c. **Carbon** burns when heated in the air. All **organic** ed, owing to the separation of carbon.

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retain an alkaline reaction after strong ignition in the inner flame. Many **Silicates** (*e. g.* **Sodium** decrepitates. **Metallic Antimony, Lead, Cadmium, Tellurium, Bis-Copper, Silver, Gold,** with difficulty. The six first metals give an incrustation of oxide.

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es, &c.

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metals. When ignited they become vividly incandescent, with a white light: after ignition **cates. Metallic Iron, Nickel, Cobalt, Molybdenum, Wolfram, Platinum,** ie blowpipe.

---

ice), **Tin, Titanium, Niobium, Antimony,** become yellow: those of **Lead, Bismuth,**

Reddish-yellow.	Yellow-green.	Green.	Blue.
Calcium.*	**Barium,*** **Molybdenum.**	**Cupric oxide,†** **Phosphoric acid,‡** **Boric acid,‡** **Tellurous acid.**	**Arsenic,** **Antimony,** **Lead,** **Selenium,** **Cupric chloride.†**

of chloride of silver: the coloration is transitory.
ic acid.

Green mass.	Flesh-red mass.	Brown or brick-red mass.	Grey mass.
ie, anhyd., } yellowish-green.	**Magnesia,** **Tantalic anhyd.**	**Baryta.**	**Glucina,** **Lime,** **Strontia.**
) of Tin, bluish-green.			
dic anhyd., nhyd., } dirty-green.			

---

l, without Incrustation.		Metal, with Incrustation.	Incrustation, without Metal.
ng scales.	Grey infusible powder.	**Antimony,** M. brittle. Inc. white.	**Zinc,** white, not volatile in outer flame.
hite.	**Nickel,** **Cobalt,** **Iron,** **Molybdenum,** **Wolfram,** **Platinum,** **Iridium.**	**Bismuth,** M. brittle. Inc. brown-yellow.	**Cadmium,** brown-red.
.		**Lead,** M. malleable. Inc. yellow.	**Tellurium,** white.
w.			

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blimate.	White sublimate.	Fused sublimate.	Water.
and **Mercury** especially on carbonate of	**Arsenides,** crystalline. **Antimonides** } fusible. **Tellurides** } fusible. Many **Ammonium-salts.**	Higher **Sulphides** (brown-yellow). **Selenides** and **Selenium** (blackish-red). **Sulphide of Arsenic.**	All **Hydrated salts.**

---

nging to green and dark-brown.	Blue, changing to dark-brown.	Green.
Molybdic acid.	**Niobous acid.**	**Chromic acid.**

Table II.

II. Behaviour of Metallic Oxides before the

A clear bead is formed by fusing the flux on a loop made at the end of a platinum-wire: the bead is d
flame, it is sometimes advisable to employ charcoal instead of platinum-wire. The colour of the be
h. signifies hot; c. cold; supers. that the bead is supersaturated

Colour of the Bead.	With Microcosmic Salt.	
	In outer or oxidising Flame.	In inner or reducing Fl
Colourless.	*Silica* swims undissolved. *Alumina, Stannic oxide.* All *Alkaline earths,* and *Earths* (supers. opaque). *Tantalic, Niobic, Titanic, Tungstic anhydrides; Zinc-, Cadmium-, Lead-, Bismuth-, Antimonic oxides* not sat.: (supers. yellowish).	*Silica* swims undissolved. *Alum alkaline earths* and *earths* (super *Ceric, Didymic, Manganic, Stan*
Yellow or brownish.	h. not sat. *Ferric* and *Ceric oxides.* h. *Vanadic anhyd., Uranic oxide, Oxide of Silver.* c. *Nickel-oxide.*	h. *Ferric oxide* (reddish), *Titan*
Red.	h. *Nickel-oxide.* h. supers. *Ferric* and *Ceric oxides.*	h. *Ferric oxide.* c. *Titanic* and *anhyd. containing iron* (blood-r *pric oxide.*
Violet or Amethyst.	*Manganic* and *Didymic oxides.*	c. *Titanic anhyd. Niobous an* sat.).
Blue.	*Cobalt-oxide.* c. *Cupric oxide.*	*Cobalt-oxide. Tungstic anhyd. anhyd.* (supers.)
Green.	h. *Cupric oxide, Molybdic anhyd., Ferric oxide containing cobalt or copper.* c. *Chromic* and *Uranic oxides.*	c. *Chromic* and *Uranic oxides,* and *Molybdic anhyd.*
Grey and Opaque.		c. *Oxides of Silver, Zinc, Cadmi Bismuth, Antimony: Tellurous*

the Blowpipe with Microcosmic Salt and Borax.

is dipped into the finely-powdered substance under examination, and again heated. In heating in the inner e bead frequently varies with its temperature, and with the quantity of oxide employed. In this table ed with oxide ; not sat. that it is not completely saturated with oxide.

Flame.	With Borax.	
	In outer or oxidising Flame.	In inner or reducing Flame.
mina. All en. opaque). *nic oxides.*	*Silica, Alumina, Stannic oxide.*—Supers. opaque : *Alkaline earths* and *Earths, Oxide of silver, Tantalic, Niobic, Tellurous anhydrides.*—Not sat.: *Titanic, Tungstic, Molybdic anhydrides, Zinc-, Cadmium-, Lead-, Bismuth-, Antimonic oxides.*	*Silica, Alumina, Stannic oxide.*—Supers. opaque ; *Alkaline earths* and *Earths, Lanthanic and Ceric oxides, Tantalic anhyd. Manganic* and *Didymic oxides.* h. *Cupric oxide.*
ic anhyd.	h. *Vanadic anhyd.* h. not sat. *Ferric* and *Uranic oxides.* h. supers. *Lead-, Bismuth-,* and *Antimonic oxides.*	h. *Tungstic anhyd., Titanic, Vanadic,* and *Molybdic anhyd.* (brownish).
d *Tungstic* red). *Cu-*	h. *Ceric* and *Ferric oxides.* c. *Nickel-oxide* (red-brown). h. supers. *Chromic oxide.*	c. *Cupric Oxide* (supers. opaque).
hyd. (not	*Manganic* and *Didymic oxides. Nickel-oxide containing cobalt.*	
Niobous	*Cobalt-oxide.* c. *Cupric oxide.*	*Cobalt-oxide.*
Vanadic	c. *Chromic oxide, Vanadic anhyd.* h. *Cupric oxide, Ferric oxide containing copper or cobalt.*	*Ferric, Uranic, Chromic oxides.* c. *Vanadic anhyd.*
n, Lead, nhyd.		The same as with microcosmic salt. Also *Nickel-oxide,* and (supers.) *Niobous anhyd.*

Table III.

III. Conversion of Insoluble Su

When a finely powdered substance is neither dissolved by successive treatment with *water, dilute or co* a manner as to give an idea of the nature of the insoluble substance, it must be *rendered soluble*, in order t many cases on the results of the preliminary examination, which must therefore be performed with ca compound is finely powdered, and fused with 4 times its weight of carbonates of potassium and sodium, contain *arsenic* or *any easily reducible metal* (antimony, tin, lead, bismuth, &c.), the fusion must not be e

1. Sulphates (of Barium, Strontium, Lead).

Heated on charcoal with carbonate of sodium, they give an alkaline sulphide.

Sulphates of barium and strontium are rendered soluble by fusion with 4 pts. alkaline carbonate. After treatment with water, the solution contains the *acid*, the residue the *base*, which is now soluble in hydrochloric acid. — *Sulphate of lead* gives a metallic globule when heated with carbonate of sodium, is blackened by sulphide of ammonium, and is soluble in basic tartrate of ammonium. — *Sulphate of calcium* is slightly soluble in water.

2. Silica and Silicates.

Swim undissolved in a bead of microcosmic salt.

Those silicates which are not decomposed by hydrochloric acid are rendered soluble by fusion with 3 to 4 pts. alkaline carbonate (or hydrate of barium), treatment with hydrochloric acid, and separation of silica by evaporation with free hydrochloric acid : or by hydrofluoric acid (p. 54). In both cases the substance must be very finely powdered.

3. Flu (Fluor-

When treated with evolve *hydrofluoric* glass : if silica be pre is evolved, which g contact with water.

Rendered soluble alkaline carbonate (v if necessary), and dig The solution contains the *bases*, which are chloric acid.

6. Binoxide of Tin, or Antimonic Anhydride.

Heated on charcoal with carbonate of sodium, they give a metallic globule (soft or brittle): are coloured by sulphide of ammonium.

Rendered soluble by fusion with 3 to 4 pts. alkaline carbonate. Are soluble in excess of yellow sulphide of ammonium.

7. Tantalic, Tungstic, Titanic, Niobous Anhydrides.

Give with microcosmic salt a *blue, violet*, or (in presence of iron) a *blood-red* bead ; with zinc and hydrochloric acid, a *coloured* solution.

Rendered soluble by fusion with 6 pts. acid sulphate of potassium (or alkaline carbonate) (pp. 106, 171).

8. Chloride, Bro Silver. Su lybdenum,

Chloride, bromide give metallic silver bonate of sodium, or treated with zinc and

Sulphide of lead with carbonate of sod it gives sulphate of *molybdenum* gives a with microcosmic sal converted into molyb gives a blue colour chloric acid.

bstances into Soluble Compounds.

ncentrated hydrochloric or nitric acid, or aqua-regia, nor decomposed or attacked by the acids in such hat its constituent elements may be determined in the wet way. The method of doing this depends in re. In case no *distinct* indication of the treatment to be adopted is obtained, according to this table, the the fused mass exhausted with water, and the residue treated with hydrochloric acid. If the compound ffected in a platinum crucible.

orides.

spar, &c.)

l concent. sulphuric acid, *acid,* which corrodes sent, fluoride of silicon ives a precipitate on

by fusion with 4 pts. vith addition of silica estion with hot water. the *acids,* the residue now soluble in hydro-

4. Alumina or Aluminates.

Give a *blue* infusible mass when heated with cobalt-solution.

Rendered soluble by fusion with 3 to 4 pts. acid sulphate of potassium (or alkaline carbonate) and treatment with water or hydrochloric acid.

5. Chromic Oxide.

(Chrome-iron-ore.)

Gives a *green* bead in both flames with borax or microcosmic salt.

Rendered soluble by fusion with acid sulphate of potassium, or with alkaline carbonate and nitre. Chrome-iron-ore, by successive fusion with both fluxes (p. 176).

mide, Iodide of phides of Mo- Lead, &c.

and iodide of silver hen fused with car- with lime ; or when dilute sulphuric acid. ives a metallic globule um : with nitric acid lead. *Sulphide of* yellowish-green bead : by roasting it is lic anhydride, which ith zinc and hydro-

9. Metals.

(Osmide of Iridium, or residues of Platinum-ores.)

The insoluble substance has metallic lustre, or is a black powder, not affected by ignition.

Rendered soluble by igniting the powder, mixed with chloride of sodium, in a stream of chlorine : or by fusion with potash and chlorate of potassium.

10. Carbon.

The insoluble substance is black (as diamond, colourless) ; and disappears when strongly ignited in an open platinum crucible, or before the blowpipe.

Detonates when fused with nitre, forming carbonate of potassium : yields carbonic anhydride when ignited with oxide of copper.

Table IV.

IV. Behaviour of Metallic Solutions with Hydrochloric Acid,] Ammonium, suc

Hydrochloric Acid.	Hydrosulphuric Acid.			M
	Metals which are precipitated as sulphides from their hydrochloric acid solution by *hydrosulphuric acid.*		Metals whose salts are partly *reduced* in an acid solution by *hydrosulph. acid,* with separation of sulphur.*	(T
Lead (partially), white, crystalline, soluble in much hot water, precipitated thence by sulphuric acid. **Silver**, white, curdy, soluble in ammonia, precipitated thence by nitric acid. **Mercury as subsalt**, white, finely-divided, blackened by ammonia.	*Soluble in sulphide of ammonium.* **Arsenic** (yellow). **Antimony** (orange). **Tin*** (brown or yellow). **Gold**, **Platinum**, **[Iridium]** (black-brown). **Molybdenum**† (brown). **[Selenium]** (red-yellow). **[Tellurium]** (black).	*Insoluble in sulphide of ammonium.* **Mercury***, **Silver**, **Lead**†, **Copper** (black). **Cadmium** (yellow). **Bismuth** (brown). **[Palladium]**‡, **[Osmium]**, **[Rhodium]**, **[Ruthenium]** (black-brown).	**Iron as ferric salt.** The solution becomes colourless, and contains a ferrous salt. **Chromium as chromate.** The solution becomes green, and contains a chromic salt.	Nic Cob Iro Ura Ma Zin
* In a saturated solution of a barium-salt, hydrochl. acid gives a white precip. readily soluble in water. In an *alkaline* solution, hydrochloric (or nitric) acid gives a precipitate in presence of *Silicic*, *Boric*, *Antimonic*, *Tungstic*, *Molybdic*, *Benzoic* acids; or of those metals whose oxides are soluble in alkalis (aluminium, &c., soluble in excess of acid); or of *cyanides* and *ferrocyanides;* or of those *sulphides* which are soluble in sulphide of ammonium. In presence of soluble *polysulphides* or *hyposulphites*, sulphur is separated.	* SnS is brown, SnS^2 yellow. From the solution of SnS in sulphide of ammonium, hydrochl. acid precipitates yellow SnS^2. † The sulphides of *Wolfram* and [*Vanadium*] are not precip. by hydrosulph. acid from an acid solution: but they are when their solution in sulphide of ammonium is decomposed by an acid.	* Mercury as protosalt is precip. white by a little hydrosulph. acid; black by excess. † Lead is only precip. completely from dilute, not too acid, solutions. ‡ The sulphides of all the platinum-metals are precipitated very slowly.	* Sulphur is also separated in presence of free *chlorine*, *bromine*, and *iodine*, of *sulphurous*, *nitrous*, *hypochlorous*, *chloric*, *iodic*, *bromic acids*, &c.: and generally in presence of easily reducible salts of metals which are not precip. as sulphides from an acid solution.	* S cobal in ac acids slight phide a bro † S solub

The metals enclosed thus [ ] are very rare, an

ydrosulphuric Acid, Sulphide of Ammonium, and Carbonate of essively applied.

Sulphide of Ammonium.			Carbonate of Ammonium.	
als which are precipitated by *sulphide of ammonium*, in presence of chloride of ammonium. solution should be neutralised with ammonia before adding sulphide of ammonium.)			Metals which are precipitated neither by *hydrosulphuric acid* nor by *sulphide of ammonium*. *Carbonate of ammonium*, in presence of chloride of ammonium,	
As Sulphides:	*As Hydrates:* also precip. by ammonia.	*As Salts:* also prec. by amm.	*precipitates* *	*does not precip.*
el * lt } (black). ium (black-brown). ganese (flesh-red). † (white).	a. soluble in potash. **Aluminium** * } (colourless). [Glucinum] } **Chromium** (green). [Tantalum] †. [Niobium]. b. insol. in potash. [Cerium] [Lanthanum] [Didymium] [Yttrium] [Erbium] [Terbium] [Zirconium] [Thorium] [Titanium] } generally colourless.	a. in presence of phosphoric acid. **Magnesium** (crystalline). b. in presence of phosphoric, oxalic, boric or hydrofluoric acid. **Calcium** * **Strontium** } (white) **Barium** as phosphates, oxalates, borates, or fluorides.	**Barium** **Strontium** } (white) **Calcium** as carbonates.	a. precipitable by phosphate of sodium (and ammonia). **Magnesium** (crystalline). b. not precip. by phosphate of sodium. **Potassium.** **Sodium.** [Lithium].* **Ammonium.**
lphides of nickel and are difficultly soluble ic and dilute hydrochl. Sulphide of nickel is y sol. in yellow sulof ammonium, forming rn solution. lphide of zinc is in- in acetic acid.	* In presence of phosphoric acid aluminium is also precip. as phosphate, sol. in potash. † Soluble after fusion with potash.	* The alkaline-earthy phosphates are insol. in potash, sol. in acetic acid. Oxalate of calcium is insol. in acetic acid.	* The precipitation is not complete unless ammonia is added, and the whole heated to boiling.	* A concentrated solution of a lithium-salt is precip. by phosph. sod. on heating.

need not be sought for except in special cases.

V. Precipitate produced by Hydrosulp

The solution should always be acidulated with *hydrochloric acid:* a white precip. indicates *Silver, M* should be expelled by evaporation to dryness (latterly in water-bath); the residue is dissolved in water, a with hydrochl. acid. The precip. produced by hydrosulph. acid is thoroughly washed, and a portion of it residue (if any), and the filtrate mixed with hydrochl. (or dilute sulphuric) acid. If the precip. thus p sulph. amm. has dissolved something. In the latter case, the whole of the precip. by hydrosulph. acid is hydrochl. acid in the sulph. amm. solution, as in A.

A. Portion soluble in

The Precipitate is *yellow* (Arsenic, Tin), or *orange-red* (

Boiled with a concentrated solution of acid sulphite of potassium (or sesquica

Filtrate.

Sulphide of Arsenic (a little *sulphide of tin*).

Precipitate by dilute hydrochl. acid, dissolve the precip. in aqua-regia, and test the solution for *arsenic* in Marsh's apparatus (p. 82). (Arsenic-stains are soluble in hypochlorite of sodium, and when dissolved in nitric acid give a yellow or red-brown precip. with ammonio-nitrate of silver). Or fuse the precip. with carbonate of sodium and cyanide of potassium, when arsenic sublimes, and *tin* remains behind in metallic state.

Sulphides (

Dissolve in aqua-regia, and test
ratus. (Antimony-stains are insol.
with nitric acid, give no precip. wit
tallic powder left in the apparatus
in hydrochloric acid, and chloride of
cates *tin*.

B. Portion insoluble in

If the solution was acidulated with hydrochl. acid in the first instance, this residue can contain neither
looked for in the an

Boil with nitric acid (quite

Residue may consist of:

Sulphur.	*Sulphide of Mercury.*	*Sulphate of Lead.*
Yellow or grey: collects in globules, in which sulphide of mercury may be enclosed.	Black, curdy. Dissolve in aqua-regia, concentrate by evaporation, and add chloride of tin: white or grey precip. indicates *mercury*	White, finely-divided. Soluble in tartrate of ammonium, reprecip. by sulphuric acid.

If *mercury* be found in this residue (the solution having been originally acidulated with hydrochl. acid), it must have been as *protosalt*.

(If the soluti

Precipitate (u
Sulphate of L

Soluble in tartr.
precip. yellow by c
of potassium.

ulphuric Acid in a warm acid solution.

Mercury as Subsalt, or *Lead* (to be examined as in Table IV.). If the solution contain free nitric acid, it a, and acidulated by hydrochl. acid: or the solution may be neutralised with ammonia, and then acidulated digested with sulphide of ammonium (if copper be present, with sulphide of potassium), filtered from the produced is *white* and *milky*, it is only *sulphur*: if it is *curdy* and more or less *coloured*, it proves that treated in the same manner: the residue insol. in sulph. amm. examined as in B: and the precip. formed by

Sulphide of Ammonium.

(Antimony).
bonate of ammonium).

Residue.

f Antimony and Tin.

the solution for *antimony* in Marsh's appa- n hypochlorite of sodium, and when treated ammonio-nitrate of silver.) The black me- is separated by levigation, washed, dissolved mercury added: a white or grey precip. indi-

The Precip. is *dark-coloured.*

It may contain also:

Sulphide of copper (traces).
„ *platinum*
„ [*iridium*]
„ *gold*
„ [*tellurium*]
„ [*selenium*]
„ *molybdenum*
„ *wolfram*
„ [*vanadium*]

detected by their behaviour to reducing agents, (chloride of tin, sulphurous acid, &c.,) and by their blowpipe reactions.

Sulphide of Ammonium.

sulphide of silver nor *sub-sulphide of mercury*. Osmium, Rhodium, and Ruthenium need only be lysis of platinum-ore.

free from hydrochloric acid).

Solution may contain: *Lead, Bismuth, Copper, Cadmium.*

n be *brown* it probably contains *palladium*, and will give a *black* precip. with iodide of potassium.)

Add dilute sulphuric acid.

ite)
id.

amm., omate

Filtrate: neutralise with ammonia.

Precipitate (*white*) *Hydrate of Bismuth.*

Its solution in as little hydrochl. acid as possible is precip. by water.

Filtrate may contain:

Copper.

The solution is *blue:* and gives a *brown* precip. when acidulated, and mixed with ferrocyanide of potassium.

Cadmium.

If copper is absent, the solution is colourless, and gives a yellow precip. with hydrosulph. acid. If copper be present, add cyanide of potass. till the blue colour disappears, and then hydrosulph. acid: a yellow precip. indicates *cadmium.*

VI. Precipitate produced by Sulphide of Amı

If *nickel* is present, the filtrate is probably brown. The precipitate is thoroughly washed, and dissolve nickel), it is tested for *cobalt* before the blowpipe (p. 147), and then completely dissolved in not too hydrochloric acid solution. The whole is then (whether there be any insoluble residue, or no) heated w any protosalt of iron that may be present into sesquisalt. (If *iron* be present, the original solution m proto- or sesquisalt.)

Excess of potash is added to the solution, the

The **Filtrate** may contain*:

Chromium, Zinc, Aluminium, Phosphate of Aluminium, [Glucinum].

Boil with excess of binoxide of lead, filter, and saturate the filtrate with a large excess of acetic acid:

Precipitate (yellow).
*Chromate of lead**: indicates presence of
Chromium.
Chromium is also precipitated by long boiling of the (green) potash solution.

Filtrate may contain:
Zinc,
Aluminium,
*Phosphate of Aluminium**,
[Glucinum.]

Remove lead from filtrate by sulphuric acid and alcohol, add excess of *carbonate of ammonium*, and digest for some time:

Precipitate may contain:
Alumina, phosphate of aluminium.
Dissolve in nitric acid, add *molybdate of ammonium*, and heat: a *yellow* precip. indicates
Phosphoric acid.
If no phosphate be present, the precip. consists of
Alumina.

Filtrate may contain:
Zinc, [Glucinum].
Divide it into 2 portions. Acidulate the 1st with acetic acid, add *hydrosulph. acid:* a whitish precip. indicates
Zinc.
Boil the 2nd for some time: a precip. indicates
[Glucinum].

* To detect traces of *aluminium* in presence of a large amount of *iron*, the sulphide of ammonium precip. is boiled at once with potash, the filtrate acidulated with hydrochl. acid, and neutralised with carb. amm.— *Chromium* may be found in the precip. or *iron* in the filtrate, according to the relative proportion of the two metals (p. 176).— If *magnesium* be present besides *chromium* or *aluminium*, it is always partially precip. by ammonia or sulphide of ammonium, as a gelatinous compound, insol. in potash: it is separated by repeated solution in hydrochl. acid, and precipitation by ammonia, in presence of excess of chloride of ammonium. The best way of separating *chromium* from *aluminium*, *iron*, and *magnesium*, is by fusion with carb. pot. and nitre (p. 176).— For separation of *phosphoric acid* from *aluminium*, see p. 61.—The precip. of *chromate of lead* should also be dissolved in nitric acid, and tested for *phosphoric acid* by molybd. amm.

Cobalt, Nickel, Manganese, Iron, Strontium, Calcium and *Magnesi* and *Zinc*† with *Iron*).
Dissolve the wa

Filtrate may contain
Cobalt, Nickel, Manganese (Zin
Acidulate *slightly* with acetic acid, s sulph. acid, and heat ge

Precipitate:
Sulphide of cobalt,
„ *nickel,*
„ *(zinc).*
Test by blowpipe for
Cobalt.
Dissolve in hydrochl. acid, boil with excess of cyanide of potassium, add potash, *when cold*, and saturate with chlorine: formation of a *black* solution indicates
Nickel (p. 146).

(
Evap. t
residu
with
a *gree*
Boil th
with
oxide
soluti
Man

† *Zinc* is not completely separated from *i* if *iron* be present, *zinc* is always found in th and is precip. as sulphide with *cobalt* and *ni* method of separating *iron* from *zinc*, as w *nickel*, and *cobalt*, is to heat the *feebly aci* acetate of sodium, when the *iron* (if presen pletely precipitated.— A solution containi when mixed with ammonia and chlor. am manganic hydrate when exposed to the air liable to be found in the ammonia-precip.

monium, in presence of chloride of ammonium.

ed off the filter in warm dilute hydrochloric acid. If a *black* residue remains (sulphides of cobalt and much hot hydrochloric acid, with addition of a little nitric acid or chlorate of potassium, and added to the ith a little nitric acid or chlorate of potassium, in order to decompose the hydrosulphuric acid, and to convert ust be tested by sulphocyanate or ferricyanide of potassium (p. 156), to ascertain whether it is present as a

e whole gently heated, and filtered when cold:

The **Precipitate** may contain:

Uranium, and the rare earthy metals whose hydrates are insol. in potash]: *Phosphates of Barium, ium: Oxalate* and *Fluoride of Calcium* (also *Aluminium* and *Chromium*, with *Iron* or *Magnesium:*

ished precip. in a little hydrochl. acid, and add ammonia and chloride of ammonium:

†:
c, Magnesium).
iturate with hydro-
ntly:

Filtrate:
Manganese.
Magnesium.)
dryness, and fuse
on platinum-foil
arb. sod. and nitre:
a colour indicates
Manganese.

original substance
itric acid and bin-
of lead: a *purple*
a indicates
ganese (p. 150).

Precipitate may contain:
Iron [*Uranium*, and the rare earthy metals]; *phosphates of Barium, Strontium, Calcium*, and *Magnesium; oxalate* and *fluoride of Calcium:* (also *Aluminium, Chromium*, and *Manganese*).

Digest the precip. with a concent. solution of carbonate of ammonium: ‡

Residue may contain:
Iron; phosphates of Barium, Strontium, Calcium, and *Magnesium: oxalate* and *fluoride* of *Calcium.*

Dissolve in as little hydrochl. acid as possible, and test for each constituent in a separate portion, as follows:

a. For *iron*, by sulphocyanate or ferrocyanide of potassium.
b. For *barium* and *strontium*, by sulphate of calcium.
c. For *magnesium*. Add acetate of sodium, and then ferric chloride till a red colour is produced, heat to boiling, filter, precipitate filtrate with carb. amm., and test with phosphate of sodium.
d. For *phosphoric acid*, by molybdate of ammonium.
e. For *oxalic acid*. Acetate of sodium precips. white oxalate of calcium, insol. in acetic acid, converted by ignition into carbonate. §
f. For *fluorine*, with the original substance, as at p. 46.

Solution may contain:
[*Uranium.*] ‖
[*Cerium.*]
[*Lanthanum.*]
[*Didymium.*]
[*Yttrium.*]
[*Thorium.*]
[*Zirconium.*] } ¶

on by potash: hence, ammoniacal solution, *cel.* A more accurate l as from *manganese*, *ulated* solution with as sesquisalt) is com- ; a manganous salt, n., gradually deposits hence *manganese* is

‡ This is only necessary when the presence of the rare earthy metals is suspected.

‖ If *uranium* is present, the solution, when neutralised by hydrochl. acid, gives a brown precip. with ferrocyanide of potassium. *Uranium* is also precip. by boiling the carb. amm. solution.

¶ These metals mostly form difficultly soluble double salts with potassic sulphate (pp. 167—169).

§ If *phosph. acid and iron* are present, acetate of sodium throws down a yellowish flocculent or gelatinous precip. of ferric phosphate. In this case the presence of *oxalic acid* must be proved either by igniting the precip., or as follows:— Without adding acet. sod. remove barium, strontium, and calcium by sulphuric acid and alcohol, filter, boil off alcohol from filtrate, precip. iron by ammonia, filter, and add sulphate of calcium to filtrate: a white precip., insol. in acet. acid, sol. in hydrochl. acid, indicates *oxalic acid.*

VII. Precipitate produced by Carbonate of Ammonium,

This precipitate may consist of carbonates of *barium*, *strontium*, and *calcium*. It is washed and di

Portion I.	Portion II.	Portion I
Add *sulphate of calcium*.	Add * dilute sulphuric acid in excess, filter, neutralise the filtrate with ammonia, and add oxalate of ammonium:	a. *Barium is pr* Evaporate to dryness, digest the and set fire to the filtrate:
Immediate precip. indicates **Barium.**	A white precip. insol. in acetic acid, indicates **Calcium.**	A crimson flame i **Strontium**
Cloudiness after a time: **Strontium.**		b. *Barium is a*
Solution remains clear: **Calcium.**	* The addition of sulphuric acid is unnecessary if barium and strontium are absent.	If the solution gives no precip. w even after long standing, and gi time with sulphate of calcium, *stro*

GROU

VIII. Metals which are not precipitated either by hydrosulp

Evaporate a moderate quantity of the solution on platinum-foil: if no residue is left after ignitio solution into 2 portions, one

Smaller Portion.	Larger Portion.
Add *phosphate of ammonium and free ammonia:* a white crystalline precip. indicates **Magnesium.** The precip. forms very slowly if but little magnesium is present. (If the precipitation of Group III. by carb. amm. was not effected at a boiling heat, the addition of phosph. amm. produces a slight curdy precip. of alkaline-earthy phosphate.)	a. *Magnesium is absent.* Evaporate to dryness, and ignite gen portion of the residue before the blowpipe: a *yellow* colour of the c and lithium may also be present, and should be looked for in the blowp residue with a mixture of absolute ether and alcohol, which dissolves by the crimson flame of the kindled spirit: or boil a portion of the r sodium, when the formation of a difficultly soluble salt indicates **Lith** water and add bichloride of platinum and alcohol; a *yellow* preci acid tartrate of sodium. b. *Magnesium is present.* Evap. to dryness and expel ammoniac in water, and add baryta-water to distinct alkaline reaction, and filt filtrate by carb. amm. and ammonia, filter, evap. filtrate to dryness, a proceed as in (a). — Or the magnesium may be removed by phosphat acid by chloride of barium, and of barium by sulphuric acid: filter, e test fixed residue, if any, for *potassium* and *sodium* by the blowpipe with the rest of the filtrate, as in (a).

ıin presence of chloride of ammonium and free ammonia.

ɜsolved off the filter in as little hydrochloric acid as possible, and the solution divided into 3 portions.

II.	Remarks.
resent. : residue in alcohol, filter, ndicates L *bsent.* ith sulphate of strontium, ves a cloudiness after a *ntium* is present.	If the original solution contains no metals of Groups I. and II. it may be treated at once according to this table, without precipitating by carb. amm.: for the presence of magnesium and the alkaline metals interferes with none of these reactions, except that of Portion III. a. *Barium* is best detected in presence of *strontium* and *calcium* by means of sulphate of strontium, which gives a white precip. with barium-salts. If only a trace of barium be present, the precip. does not form at once. Barium is *separated* from strontium by fluosilicic acid, alcohol being added, in which fluosilicate of barium is quite insoluble.

P IV.

ıuric acid, sulphide of ammonium, or carbonate of ammonium.

n, the solution need not be further examined, except for ammonia: if a residue is left, divide the much larger than the other.

	Ammonium.
tly, to expel ammoniacal salts. Test a uter flame indicates **Sodium**: Potassium ipe flame through blue glass. Digest the *chloride of lithium* only, to be detected esidue with carbonate and phosphate of um. Dissolve the rest of the residue in). indicates **Potassium**. Confirm with ıl salts by ignition: dissolve the residue :r. Remove excess of baryta from the ıd ignite. If any fixed residue remains, of ammonium, the excess of phosphoric vap. a portion of filtrate to dryness, and , with and without blue glass. Confirm	Ammonia must always be tested for in *a fresh portion of the original solution*, by heating it in a test-tube with *lime* or *potash*. The characteristic smell, or the formation of white fumes when a glass-rod moistened with dilute hydrochl. acid is held to the mouth of the tube, indicates **Ammonia.**

Table IX.

IX. Behaviour of the most important acids on he

A small portion of the dry substance is heated in a test-tube (not to boiling), with three or four time decomposition, or which are decomposed by sulphuric acid at a high temperature, gases or vapou

Acids which are not volatile or decomposed.

No gas or vapour is evolved. No blackening of the mixture.

Silicic, separated by evaporation with hydrochl. acid, and identified by fusion with microcosmic salt before blowpipe.

Boric, colours alcohol-flame green, after addition of sulphuric acid.

Phosphoric, detected in neutral solutions by a magnesium-salt, chloride of ammonium, and ammonia: in acid solutions by molybdate of ammonium, or ferric chloride and acetate of sodium.

Sulphuric, barium-salt insol. in acids; sulphates yield alkaline sulphides when heated on charcoal with carbonate of sodium.

†**Arsenic**, like *phosphoric;* garlic-smell when heated on charcoal with carbonate of sodium.

†**Selenic**, barium-salt decomposed by boiling with strong hydrochl. acid. Selenates yield selenides when heated on charcoal with carbonate of sodium.

†**Tungstic**, detected by blowpipe: gives *blue* colour with zinc and hydrochl. acid.

†**Molybdic**, detected by blowpipe: gives *blue* colour, changing to *brown*, with zinc and hydrochl. acid.

†**Titanic**, detected by blowpipe: *violet* colour with zinc and hydrochl. acid.

Iodic, violet vapours on addition of ferrous sulphate; iodates detonate when heated with charcoal.

† These metallic acids will have been detected in the examination for metals.

Acids which are v

A *coloured* gas is evolved. No blackening of the mixture.

‡**Hydriodic**, violet vapours, which colour starch-paste blue; black precip. with nitrate of palladium.

‡**Hydrobromic**, red vapours, which colour starch-paste orange.

Bromic, the same. Bromates detonate when heated on charcoal.

Chloric, greenish-yellow explosive gas. Chlorates detonate when heated on charcoal.

Hypochlorous, chlorine evolved, which decolorises indigo-solution.

Nitrous, red vapours, even with dilute sulphuric acid.

‡ With *dilute* sulphuric acid, these acids partially volatilise undecomposed.

No blackening of Volatile without d

Carbonic, odourless; pre

Sulphurous, smell of burn a solution of chromate

***Hydrosulphuric**, chara lours *brown* paper moi solution.

***Hydrochloric**, irritatin white fumes on conta and with silver-solution cip. soluble in ammonia

Nitric, on addition of copp sulphate, red fumes, w paste and iodide of pot

Acetic, acetic ether evol alcohol.

Benzoic, neutral benzoate precip. with ferric chlor

Succinic, the same: a sli long heating.

Hydrofluoric, fuming g glass. Metallic fluorid phuric acid in a glass ve fluoride of silicon, whi precip. of silica on cont moistened with water. have in the same way: of silicon when heated cible with sulphuric aci

* With a mixture of salts, the reactions given in this table are often modified: thus a *chloride*, in presence of a *nitrate*, ev *subchloride of mercury* and *chloride of tin* do not evolve hydrochl. acid with strong s

ting their salts with concentrated sulphuric acid.

its volume of concentrated sulphuric acid. In the case of all acids which are either volatile without
s are evolved, the properties of which, in most cases, indicate the nature of the acids present.*

ılatile, or yield volatile products of decomposition.

The vapours or gases evolved are *colourless*.

;he mixture. composition.	Decomposed by ignition.	
	Without separation of carbon.	With separation of carbon.
pitates lime-water.	**Oxalic**, evolves carbonic anhydride and carbonic oxide: its calcium-salt is insol. in acetic acid.	*Non-volatile organic acids.* The salts of all these acids blacken when heated with strong sulphuric acid, and evolve carbonic and sulphurous anhydrides, and carbonic oxide.
ıg sulphur; colours potassium *green*.	§**Formic**, evolves pure carbonic oxide, which burns with blue flame.	**Tartaric**, smell of burnt sugar. Its acid potassium-salt is difficultly sol. in water: its calcium-salt is sol. in cold potash, or sal-ammoniac.
teristic smell: cotened with a lead-	§**Hydrocyanic**, evolves carbonic oxide and ammonia.	**Racemic**, calcium-salt insol. in sal-ammoniac.
gas, which gives t with ammonia; a white curdy pre-	**Cyanic**, evolves carbonic anhyd., together with some undecomposed cyanic acid, which irritates the eyes.	**Citric**, with excess of lime-water, gives a precip. *on boiling*, which redissolves on cooling.
r filings, or ferrous ich colour starch- sium *blue*.	**Sulphocyanic**, same as hydrocyanic, with separation of sulphur.	**Malic**, no precip. with lime-water, either hot or cold.
d on addition of	**Chromic**, evolves oxygen; the solution becomes brown or green. *Green* bead with microcosmic salt.	**Tannic**, a white viscous precip. with gelatine: a blue-black precip. with ferric salts.
give light brown le.	**Hyposulphurous**, evolves sulphurous anhydride and separates sulphur. Its alkaline salts are converted into sulphides by heat. The other *polythionic acids* behave in the same way.	**Gallic**, no precip. with gelatine: a dark-blue precip. with ferric salts.
ht blackening on		**Uric**, after evaporation with nitric acid, a purple colour with ammonia.
, which corrodes , heated with sul- sel, evolve gaseous h gives a white t with a glass-rod *Fluosilicates* be- ıey evolve fluoride ın a platinum cru-		

§ With *dilute* sulphuric acid, these acids volatilise undecomposed, at least partially. Ferro- and ferricyanides behave like cyanides: they are detected in solutions by their reactions with ferric and ferrous salts.

lves chlorine and red nitrous fumes: in presence of a *chromate*, red fumes of chlorochromic acid (p 26), &c[a] *Chloride* and

Table X.

X. Behaviour of the most important

A. *Examination for acids in soluble compounds.*—With an aqueous solution the first step is to test v slightly alkaline solution, it is generally necessary to begin by removing all the metals contained in th *oxalates, phosphates,* &c. will be detected. The nature of the metals found will often imply the absenc a solution containing *barium*, nor *hydrochloric acid* in a solution containing *silver*. This is invariably t acid has been *added* (for neutralisation or solution) of course it is impossible to test for that acid in th instead of the reagent indicated in the table, to use the *nitrate* of the same base (since nitric acid form silver. These remarks apply also to Table XI., which is a continuation of this table.

Hydrochloric or Nitric Acid precipitates:

from a neutral or slightly alkaline solution.

Silicic, gelatinous: in dilute solutions only after evaporation: precip. also by chloride or carbonate of ammonium.

Boric, crystalline: from concentrated solutions only: green alcohol-flame on addition of sulphuric acid.

Antimonic, white, sol. in tartaric acid.

Tungstic, white, yellow on boiling: blue colour with zinc and hydrochl. acid.

Molybdic, white, sol. in excess of acid: blue colour with zinc and hydrochl. acid: yellow precip. with phosphate of ammonium.

Sulphur, white or yellowish: from *hyposulphites* with evolution of sulphurous anhydride: from *polysulphides*, of hydrosulphuric acid.

Iodine, black precip. or brown coloration: from a solution of an iodide containing iodate.

From an alkaline solution may also be precip. *oxides* and *sulphides* which are sol. in potash, and *cyanides* and *chlorides* which are soluble in cyanide of potassium. If the alkaline solution be saturated with hydrosulphuric acid, hydrochl. acid precipitates as *sulphides* those metallic acids which form insol. sulphides.

Of *organic acids, benzoic, uric,* and *tartaric* (as acid tartrate of potassium) are precip. by acids from alkaline solutions.

Chloride (or Nitrate) of Barium precipitates:

from a solution acidulated with nitric or hydrochloric acid.

Sulphuric, white, finely divided. (If too much free acid be present, chloride or nitrate of barium may be precip.: sol. on adding water.) The precip. yields an alkaline sulphide when heated on charcoal with carb. sod.

Selenic, the same. The precip. heated with strong hydrochl. acid evolves chlorine, and sulphurous acid precips. red selenium from the solution: heated on charcoal with carb. sod. it gives a smell of horseradish.

Fluosilicic, gelatinous, hardly visible: decomposed by strong acids. The precip. heated alone yields fluoride of silicon and fluoride of barium: with alkalis, silica and metallic fluorides.

from neutral solutions (precip. being sol. in acids):

Sulphurous, **Phosphoric**, **Carbonic**, **Silicic**, **Hydrofluoric**, **Oxalic**, **Boric**, **Tartaric**, **Citric**, **Arsenic**, **Arsenious**, (not if amm. salts are present.) } white.

Chromic, yellow.

Chlo

from a neutral solu (precip. is sol. in ac

Phosphoric, white, s acid when freshly p

Arsenic, the same, sol of amm. The acid tion is precip. by acid.

Boric, white, sol. in not precip. from dilu Turmeric-paper dip solution of the pre drochl. acid is b drying.

Carbonic, white, so with effervescence.

Sulphurous, white, dilute solutions. O of chlorine-water t solution of the prec of calcium is precip.*

Tartaric, white, sol. amm. or potash: solution is precip. by

Citric, white, not unt ammonia or lime-wat and the whole boiled

Ferrocyanides are slowly: yellowish, sol. in acetic acid.

* This reaction is much with chloride of barium.

acids with reagents in the wet way.

th litmus-paper whether it is *acid, neutral,* or *alkaline.* As many acids must be sought for in a neutral or solution, except the alkaline metals, by Table IV.: in which process the metallic acids and alkaline-earthy of one or more acids, so that they need not be looked for: thus *sulphuric acid* need not be looked for in ıe only in *neutral* or *acid* solutions: in *alkaline* solutions there are exceptions: see below. When an solution: a fresh portion of the substance under examination must be taken. It is sometimes necessary, no insoluble salts): *e. g.* nitrate must be substituted for chloride of barium for solutions containing lead or

·ide of Calcium precipitates:

ion only tic acid).

from a neutral or acetic acid solution (precip. is insol. in acetic acid).

. in acetic cip. in chloride ated solu- ydrosulph.

ılor. amm. solutions. d in the p. in hy- wn after

in acids

not from addition the acid). sulphate

in chlor. ıe potash boiling. excess of r is added

ecipitated difficultly

ıore delicate

Oxalic, white, insol. in chlor. amm.: after ignition effervesces with acids. Sulphate of calcium gives the precip.

Racemic, white, insol. in chlor. amm. Sulphate of calcium gives the precip. after a time.

Hydrofluoric, gelatinous: with strong sulphuric acid the precip. evolves hydrofluoric acid, which corrodes glass.

Sulphuric, white: not from dilute solutions: completely on addition of alcohol.

Sulphate (or Chloride) **of Magnesium precipitates:**

in presence of chloride of ammonium and free ammonia.

Phosphoric, white, crystalline, sol. in all acids: forms slowly in dilute solutions.

Arsenic, the same. The acidulated solution is precip. by hydrosulph. acid.

Tartaric, white, forms slowly: only from concent. solutions. The precip. blackens on ignition.

Separation of Oxalic, Tartaric, Citric, and Malic Acids.

Add chloride of calcium and lime-water to alkaline reaction.

Precipitate.
Oxalate, Tartrate of calcium.

Digest with cold potash.

Residue.	Filtrate.
Oxalate of calc.	*Tartrate* of calc.
Insol. in acetic acid or chloride of copper: sol. in hydrochl. acid.	Precipitated gelatinous on boiling the alkaline solution, redissolved on cooling.

Filtrate.
Citrate, Malate of calcium.

Heat to boiling.

Precipitate.	Filtrate.
Citrate of calc.	*Malate* of calc.
Sol. in chloride of copper.	Precipitated by addition of alcohol after evaporation.

Table XI.

XI. Behaviour of the most important acids

Sesquichloride of Iron		
Gives a precipitate.	Gives a coloration.	From a *neutra*
a. *In presence of free hydrochl. acid.*	a. *In presence of free hydrochl. acid.*	*The precip. is so a*
Ferrocyanides, deep-blue: the precip. is decomposed by potash into ferric hydrate and ferrocyanide of potassium.	**Ferricyanides**, brown. Ferrous salts give deep-blue precip.	**Phosphoric**, yell molybdate of a
b. *In a solution which is neutral, or contains free acetic acid* (obtained by adding acetate of sodium to the hydrochl. acid solution).	**Sulphocyanic**, blood-red: destroyed by chloride of mercury, not by hydrochl. acid.	**Arsenic**, red-brow low. Original by hydrosulph.
Phosphoric, yellowish-white: insoluble in acetic acid, sol. in hydrochl. acid or ferric acetate.	b. *In neutral solutions only.* (The colour is destroyed by hydrochl. acid.)	**Chromic**, red. T or red solution i sulphurous acid
Arsenic, the same: acid solution precip. by hydrosulph. acid.	**Acetic**, red-brown. The original compound, heated with sulphuric acid and alcohol, forms acetic ether.	**Oxalic**, white: in The calcium-sa acetic acid.
Tannic, black-blue. The original solution is precip. by gelatine.	**Formic**, the same. The original compound reduces silver- and mercuric salts, with evolution of carbonic anhyd.	**Boric**, white: sol green alcohol-fl
c. *In a neutral solution only.*	**Sulphurous**, the same. The colour disappears on boiling, without a precip. The original compound evolves sulphurous anhyd. when treated with hydrochl. acid.	**Tartaric**, white: duced on boilin
Boric, yellowish: its hydrochl. acid solution colours turmeric-paper brown.	**Meconic**, blood-red; not changed by chloride of gold.	**Citric**, white.
Benzoic, light-brown: hydrochl. acid gives a white crystalline precip. in the original concent. solution.	**Gallic**, black. The original solution is not precip. by gelatine.	**Silicic**, yellow, fro
Succinic, the same. The concent. solution of the ammonium-salt (obtained by digesting the ferric salt in ammonia), is precip. by chloride of barium, in presence of alcohol and free ammonia (distinction fr. *benzoic.*)		All these precip monia. *Pyro-* an acids are precip. after addition of a by albumen. A an *acetate* is pr silver, crystalline.
		Sulphurous and white precips., duce metallic si

B. *Examination for acids in compounds which are insol. in water or acids.*—The nature of the co
Inorganic compounds (those which do not blacken when heated) are decomposed by fusing them, finely
fused mass with water: the aqueous solution contains the acids, and is neutralised with hydrochl., nitri
decomposed by digestion in sulphide of ammonium, alkaline-earthy sulphates by boiling with a concent.
aqua-regia, form *sulphuric acid.* Insoluble salts of *organic* acids are decomposed by boiling with an
alkaline salt of the acid, and is examined by Tables X. and XI.

with reagents in the wet way (continued).

Nitrate of Silver precipitates		Indigo-solution is decolorised by.
solution only.	From an *acid* solution also.	
. *in dilute nitric* :*d.* *v.* Confirm with monium. ı. **Arsenious**, yel-:id solution precip. cid. ıe original yellow coloured green by :ol. in acetic acid. ; is also insol. in ble in acetic acid : ne. ıetallic silver re- ı concent. solution. are soluble in am-. *metaphosphoric* white : the latter, :tic acid, is precip. ıncent. solution of cip. by nitrate of 'ormic acids give ıd on heating re-ver.	*The precip. is insol. in dilute nitric acid.* **Hydrochloric**, white, curdy, sol. in ammonia, or hyposulphite sod. **Hydrobromic**, the same ; less sol. in ammonia. The original solution colours ether yellow on addition of chlorine-water. **Hydriodic**, yellow ; scarcely sol. in ammonia. Original solution gives blue colour with starch and nitrous fumes. **Iodic**, white : sol. in ammonia, whence sulphurous acid precips. iodide of silver. Original solution, in presence of an iodide, gives blue colour with starch and acetic acid. **Hydrocyanic**, white, curdy; sol. in ammonia, hyposulphite sod., and cyanide potass. Original solution gives Prussian blue with ferroso-ferric salts, potash, and hydrochl. acid. **Ferrocyanides**, white ; insol. in ammonia. Original solution gives dark-blue precip. with ferric salts. **Ferricyanides**, red-brown. Original solution gives dark-blue precip. with ferrous salts. **Sulphocyanic**, white; difficultly sol. in ammonia. Original solution is coloured red by ferric chloride. **Hydrosulphuric**, black ; insol. in ammonia : lead and copper-salts give black precip. Alkaline sulphides give purple colour with nitroprusside of sodium.	a. *Without addition of an acid.* Free **Chlorine** and **Bromine**: all the **oxygen-acids of chlorine** (free), and metallic **hypochlorites**: free **nitric acid**, if not too dilute. Also **alkaline sulphides** and **caustic alkalis.** b. *On addition of an acid (hydrochl. or sulphuric) and heating.* **Chlorates**, converted into chlorides by ignition. **Nitrates**, brown colour with ferrous sulphate and sulphuric acid. **Iodates**, the dry salt gives violet fumes with ferrous sulphate and sulphuric acid. **Bromates**, give red bromine-vapours with sulphuric acid. c. *Evolve chlorine (and so bleach indigo) when heated with concentrated hydrochl. acid.* All the foregoing compounds : also **Chromates.** **Selenates.** **Tellurates.** **Manganates** and **Permanganates.** All **Peroxides.**

ıpound, and the acids probably present, are ascertained by a preliminary examination by Tables I. II. and IX. powdered, with four times their weight of *pure* carbonates of potassium and sodium, and extracting the , or acetic acid, and examined by Tables X. and XI. Insoluble compounds of the heavy metals may be olution of carbonate of sodium : the filtrate contains the acid. Sulphides, when treated with nitric acid or kaline carbonate ; ferric salts of volatile organic acids by digestion with ammonia : the filtrate contains the

Table XII.

XII. Behaviour of na

Natural silicates behave very variously, when finely powdered and treated with mineral acids. Some are wl majority separate silica in the *gelatinous* form: others (which are generally decomposed with greater difficul evaporated, deposits gelatinous silica. Some (*e. g.* most zeolites) are less readily acted on by acids after ign acts most generally on silicates is sulphuric acid: but hydrochloric acid is the most convenient for general ap action of acids are decomposed by fusion with 3—4 pts. carbonates of potassium and sodium, or, in the case

The minerals marked Z

Decomposed by acids.

(a.) *Completely sol. in dilute acids.*

Allophane.
Collyrite.
Z. Gismondine; zeagonite.
Kielhauite; yttrotitanite.

(b.) *Separate gelatinous silica.*

Z. Aedelforsite.
Allanite; orthite; cerin.
Z. Analcime.
Z. Apophyllite.

Barsowite.
s. Biotite; uniaxial or magnesia-mica.
Bismuth-blende; eulytine.

Cancrinite; davine.
Cerite.
Z. Chabasite; levyne.
Chamoisite.
Chondrodite.
Cronstedtite.

Datolite; botryolite.
Diaptase.

Eudialite.

Gadolinite (bef. ig.).
Galmei; willemite.
Gehlenite.
Z. Gmelinite; sarcolite; hydrolite.

s. Hallo ysite; lensinite; tuesite.
Hauyne; lasurstein; nosean.
Helvine.

Z. Heulandtite.
Hisingerite; thraulite.
Humboldtilite; melilite.

Z. Ittnerite.

Knebelite.

Z. Laumonite.
Lievrite; ilvaite.

Meerschaum.
Meionite.
Z. Mesotype; mesole; mesolite; natrolite; poonahlite; scolezite.

Nepheline; elaeolite.
Nontronite.
Z. Okenite; dysklasite.
s. Olivine; chrysolite; peridot; hyalosiderite.

Z. Pectolite.
Z. Potash-harmotome; phillipsite.

Schrötterite.
Sideroschisolite.
Sodalite.
Spadaite.
Z. Stilbite; desmine.

Tcheffkinite.
Z. Thomsonite; comptonite.
Thorite.

Wolchonskoite.
Wollastonite; table-spar.

(c.) *Gelatinise after ignition.*

Axinite.
Epidot; pistazite; zoisite.
Garnet; pyrope.
Idocrase; vesuvian.

Lepidolite.
Z. Prehnite.
s. Tourmaline.

(d.) *Separate pulverulent silica.*

Amphodelite.
Anorthite.
Antigorite (flocculent).

Z. Baryta-harmotome; cross-stone.

Chonicrite; vermiculite.
Chrysocolla.

s. Damourite (pearly scales).

Z. Epistilbite (bef. ig.).

Lepidomelan (pearly scales).
Leucite.

Pennine.
Pinguite.
Pollux.
Pyroxklerite.

Ryacolite.

(e.) *Separate silica in one of the above forms.*

hot s. Agalmatolite.
Anthosiderite.
Z. Brewsterite.
s. Chlorite; ripidolite.
Clintonite.
Z. Faujasite.

Labradorite.

Margarite.
s. Onkosine.
n. hot s. Ottrelite.

tural silicates to acids.

olly or partially decomposed: while others resist the action of acids altogether. Of the former class, the y) separate it in the form of a *powder*: a few are completely soluble in dilute acids, and the solution, when tion: others, which resist acids before ignition, are decomposed by acids after ignition. The acid which olication (p. 53). In this table, s. signifies sulphuric, and n. nitric, acid. — Those silicates which resist the f alkaline silicates, by carbonate or hydrate of barium: or by hydrofluoric acid (p. 54).
are of the zeolite family.

Palagonite.
Porcelain-spar.
Pyrargillite.
s. Pyrochlore.
n. Pyrosmalite.

Scapolite; wernerite; dipyre.
s. Schiller-spar.
s. Serpentine.
s. Soapstone.
s. Sphene; titanite.

Tachylite.
Villarsite.
Wöhlerite.

(f.) *Partially decomposed.*

Acmite.

Basalt.
Batrachite.*
Bole; fuller's earth.

Chloropal.
Cordierite; dichroite: iolite.
Z. Edingtonite.

Glaucophane.

Iopyre.*

Miloschin.

Phonolite; clinkstone.
s. Pyrophyllite.

Sordawalite.
Stilpnomelan.*

Yellow-earth.

* Very imperfectly.

Not decomposed by acids.

Albite; soda-felspar.
*Andalusite; chiastolite.
Augite; diallage; diopside; hypersthene.

Beryl; davidsonite.

Castor.
Chloritoid; chlorite-spar.
Couzeranite.
*Cyanite; disthene; buchol-zite.
*Cymophane; chrysoberyl.

Emerald.
Euclase.

Fahlunite; triclasite.
Felspar; orthoclase.

Gedrite.
Green-earth.

Hornblende; anthophyllite; asbestos; grammatite; tremolite; uralite.
Hypochlorite; green-ironstone.

Jeffersonite.

Kaolin.
Karpholite.

Oligoclase; soda-spodumen.

Paragonite; mica-slate.
Pericline; potash-albite.
Petalite.
Phenakite.
Pinite.
Pitchstone; obsidian; pumice.
Potash-mica (biaxial).

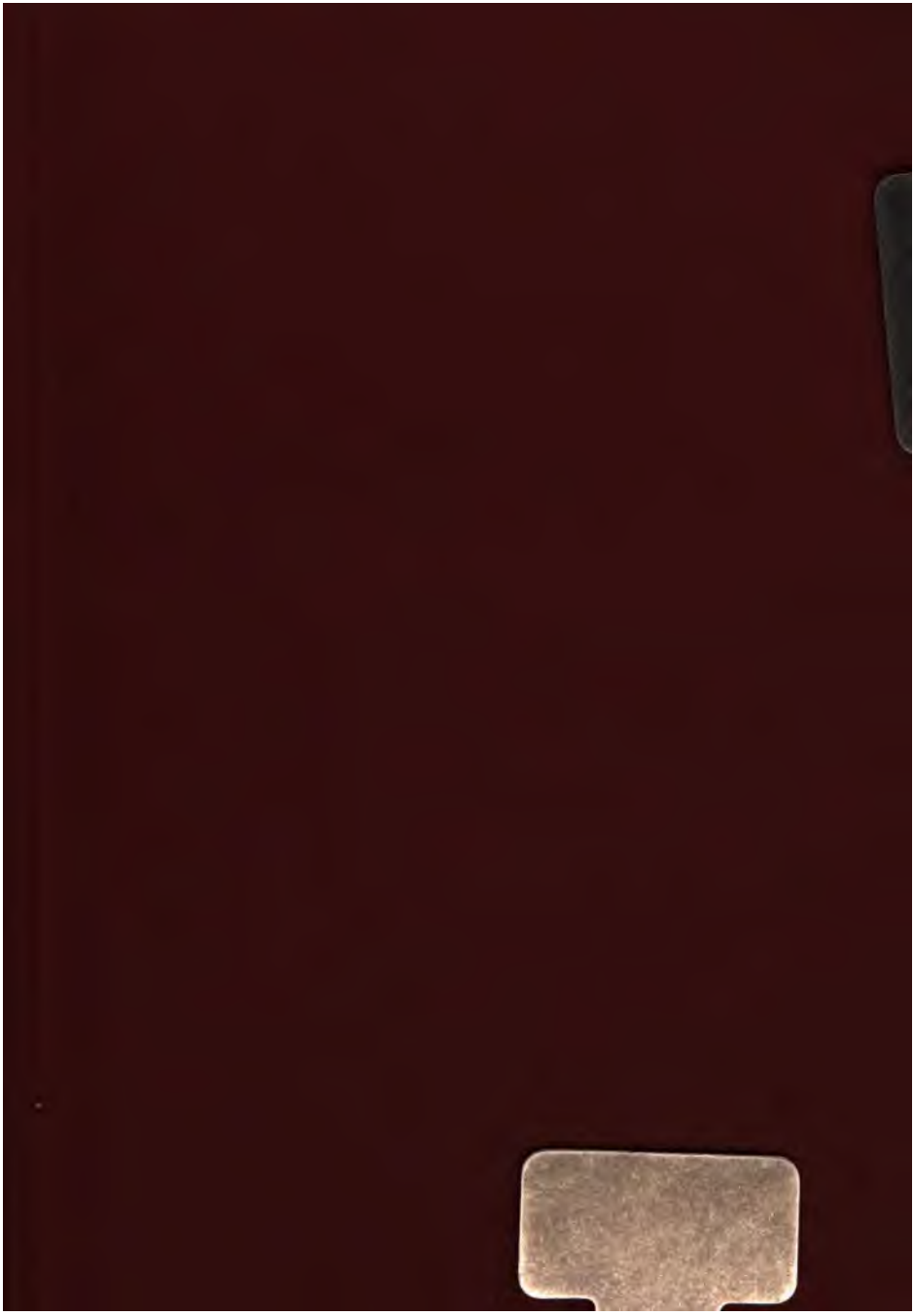
Saussurite.
*Sillimanite.
Spodumen; triphane.
* Staurolite.

Talc; speckstein.
Topaz; pycnite; pyrophysalite.

Wichtyn; wichtysite.
Wörthite.

* Zircon; hyacinth.

* Are decomposed with difficulty by fusion with alkaline carbonates, or by hydrofluoric acid (p. 54).



TABLES

FOR

QUALITATIVE ANALYSIS.

TO ACCOMPANY

CONINGTON'S HANDBOOK OF ANALYSIS.